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Research Article

EFFECT OF TANNIN AS PHYTONUTRIENT ON GROWTH PERFORMANCE OF SURTI KIDS

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Abstract: The study was conducted to evaluate the effect of *Acacia nilotica* (babul) pod meal based tannin on growth performance, nutrient utilization as well as economics of feeding on goat kids. For that, sixteen Surti male goat kids were randomly divided into two equal groups of eight each, based on age and body weight and were individually fed for 110 days as per ICAR (2013) standards. The kids were fed TMR with no tannin (T1); and TMR with 3% tannin (T2). The intake of different nutrients was similar (P>0.05) between the groups. CP digestibility was found significantly (P<0.05) higher in tannin group as compared to control group while digestibility of other nutrients remained similar in both the groups. The final body weight was significantly higher (P<0.05) for tannin group than control group. The total gain and ADG were 35.82 and 20.26 percent higher in tannin group than control group, respectively. The feed conversion efficiency (FCE) was significantly (P<0.05) better in treatment group. The feed cost per kg weight gain was reduced by 20.04% in treatment group. The realizable receipt from total gain of goat (Rs./head) in experimental groups differed (P<0.05) significantly. The return over feed cost (ROFC) was significantly higher (P<0.05) in tannin group. The net saving was Rs. 835.74 in tannin group over control during period of 110 days on account of higher return over feed cost (ROFC). It is concluded that locally available tanniniferous babul pod could be used as a feed constituent in the diets of goats.

Keywords: *Babul pod, Tannin, TMR, Surti kids*

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Introduction

In all over the world, food crisis rises as a measure problem that gives an indication to improve the use of local resources for animal nutrition such as fodder trees and shrubs [1]. According to the 2015 estimates regarding feed and fodder in India by NIANP, total demand of fodder (Green + Dry) was 1331 million tonnes, with available forage estimated to be 1006 million tonnes, a shortage of 47 million tones and this shortage will be increased to 63 million tonnes by 2025 (DM basis) [2]. Therefore, utilization of unconventional feed resources to formulate least cost ration being a major target for animal nutritionist [3]. In unconventional feed, the major problem is incriminating factors present in it like tannin, lignin etc. which leads to poor digestibility. It is observed that tannin (>5%) rich diets consumed by animals usually developed negative nitrogen balances, lowered feed digestibility and animal performance [4]. Although, tannins also have beneficial effect in ruminants such as protein sparing action, prevention of bloat, anthelmintic activity and induce improvements in growth performance [5,6]. Tannin is widely distributed to many tropical forages and shrubs (*e.g. Leucaena leucocephala, Sorghum* sp., *Acacia* sp. etc.) and many agroindustrial byproducts namely Salseed meal, Mangoseed kernel, Prosopis. juliflora, Mahua cake etc. Goats form an integral component of livestock farming system in the tropics and subtropics. *Acacia nilotica* pod (pulp + seeds) is one of the unconventional feed resources which are abundantly found in tropics and subtropics. It contains high amount of tannins 18.71%, but rich source of protein and energy (13% CP, 72% TDN) [14]. Babul pods are available in most states of India in huge quantity. Therefore, it is suggested to use it as a substitute of energy source like cereal grains in conventional rations for livestock [7,8]. Amongst all livestock species, domestic goat (*Capra hircus*) occupies a unique position and has its own significance in socioeconomic development of rural households [9]. Being the native of Asian subcontinent, they are well adapted and geographically widespread livestock species, ranging from the high altitude of the Himalayas to the deserts of Rajasthan and humid coastal areas of India. They are mostly reared by land scarce poor farmers and regarded as "poor man's cow" due to their low initial investment and operational costs [10]. Goats are considered as multi functional farm species as they offer a range of products like meat, milk, fiber and skin along with livelihood and food security to rural population. Therefore, goat production has been a tool for poverty alleviation because of low initial investment and an added source of income for many resources poor farmers.

Materials and Methods

Animals, feeding, management and dietary treatments

Sixteen Surti male goat kids (seven months old, 13.60 ± 0.58 kg BW) were randomly divided into two equal groups of eight in each group, based on age and body weight. The present study was conducted at Animal Nutrition Research Station, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand, Gujarat during the year 2018. The permission for animal experiment was granted by Institutional Animal Ethics Committee (IAEC 2018/ANRS/268).

All the experimental kids were fed on Total mixed ration (TMR) in mash form with or without tannin to meet their nutrients needs as per ICAR (2013) standards [11]. The experimental kids were housed in sheds with proper ventilation, flooring and tying arrangements. Individual feeding of all the Surti kids was followed. The kids were fed TMR without tannin and TMR with 3% tannin using *Acacia nilotica* pod meal as a source of tannin to T1 (Control) and T2 (Tannin) groups, respectively. The ingredients composition of total mixed ration is given in [Table-1]. The daily feed intake was recorded for each experimental kid during the 110 days of experimental period. The experimental kids were weighed biweekly to determine the growth performance of the animals.

The experimental kids were let loose daily for exercise (except during the period of digestion trial) in an open paddock, for two hours in the morning and one hour in the afternoon under controlled conditions during which they had free access to fresh, wholesome drinking water.

Digestion trial

A digestion trial was conducted on all the sixteen experimental kids to determine digestibility of the nutrients and plane of nutrition. The arrangement for quantitative collection of faeces was made during the trial period of 5 days. A proper record of feed consumed, refusal and faeces voided by each animal was maintained during the trial period.

Cost of feeding

The cost of feeding for experimental kids was calculated from the records of daily feed consumption and by considering the procurement price of feeds and fodder used for feeding of experimental kids. Return over feed cost was calculated taking difference of the realizable receipt from total gain of goat and the total feed cost. The realizable receipt was calculated based on the market price of goat prevailed and it was 300 Rs./kg live body weight. The net return (Rs./head/110 days) was worked out taking into consideration the difference in return over feed cost.

Laboratory analysis and statistics

The samples of TMR offered, leftover and faeces were analyzed for proximate principles as per AOAC (1995) [12] and for fibre fractions as per Van Soest *et al*. (1991). Total tannin content of *Acacia nilotica* pod meal was analyzed by method of FAO/IAEA (2000) [13].

The data generated during the experiment were subjected to one way analysis of variance (ANOVA) as per the methods of Snedecor and Cochran (1994) [14], with the help of SPSS and WASP software programme. The Completely Randomized Design was followed.

Table-1 *Ingredient composition (%) of total mixed rations (TMRs) offered to experimental Surti kids*

Ingredient	T_1 (Control)	T_2 (Tannin)
Jowar hay	45	45
soyabean meal	18.5	18.5
Maize	10	7
DORB	12	0
Wheat bran	3	0
Babul pods	0	18
Molasses	10	10
Mineral mixture	1	1
Common salt	0.5	0.5

Table-2 *Chemical composition of total mixed rations (% on DM basis)*

Parameter	T_1 (Control)	T_2 (Tannin)
Crude protein (%)	14.09	14.12
Ether extract (%)	2.67	2.88
Crude fibre (%)	21.39	20.83
Nitrogen-free extract (%)	52.42	52.71
Total ash (%)	9.43	9.46
Organic matter (%)	90.57	90.54
Neutral detergent fibre (%)	55.68	53.99
Acid detergent fibre (%)	26.43	27.5
Hemi-cellulose (%)	29.26	26.49
Calcium (%)	2.43	2.58
Phosphorus (%)	0.61	0.45

Results and Discussion

The proximate composition and fibre fractions (NDF and ADF) of both TMRs offered to experimental Surti kids is presented in [Table-2]. Babul pod containing tannin was used in this study at the level of 18% (contains 3% tannin) as optimized through *invitro* study. Both the TMRs were isonitrogenous and isocaloric.

Plane of nutrition, intake and digestibility of nutrients

The effect of feeding *Acacia nilotica* pod meal as tannin source in goats on plane of nutrition and digestibility of nutrients are presented in [Table-3]. The average DMI of kids was similar among the groups. Thus, feeding of tannin based TMR has no adverse effect on DMI. Moreover, intake of other nutrients such as CP, DCP and TDN was also nonsignificant (P>0.05) between the groups. Besides, the intake of DM, CP, DCP and TDN of experimental Surti kids for both the treatment groups was adequate [11].

In corroboration with our findings, no impact on intake values of DM, CP, DCP and TDN were reported by Paswan *et al*. (2017) [15] who fed graded level of *Acacia nilotica* pod meal @ 0, 10, 20 and 30% to the ration of kids. Besides, same results were also reported by Parthasarathi *et al*. (2016) [16], Uguru *et al*. (2014) [17], Kushwaha *et al*. (2012) [18] and Alam *et al*. (2007) [19] who added different sources of tannin to the TMR. Min *et al*. (2003) [20] reported that condensed tannin (CT) concentration (>55 g CT/kg DM) reduce voluntary feed intake but at lower level (20-45 g CT/kg DM) voluntary intake was not affected. Thus, results of the present study are in agreement with these reports.

The digestibility coefficient of CP was improved significantly (P<0.05) in treatment group as compared to control group while digestibility of other nutrients in the T2 group was found to be comparable with T1 group. Improvement in digestibility of CP might be due to better effect of tannin rich feed supplement on digestibility at moderate level or due to positive effect of tannins on gastro intestinal tract health [21]. Similar to our findings, Hidosa and Gemiyo (2017) [22] and Uguru *et al*. (2014) who fed different levels of *Acacia nilotica* pods offered to goats found similar results. Improvement in digestibility of CP on account of addition of horse gram as tannin source has also been demonstrated by Parthasarathi *et al*. (2016). Tabhani *et al*. (2016) [23] also observed at par nutrient digestibility in kids fed a diet containing *F. benghalensis* leaves to supply 1.5% CT. Similarly, Kumar *et al*. (2014) [24] also reported nonsignificant (P>0.05) difference in digestibility coefficient of DM in lambs fed a CT-based TMR having 1.5% CT through *Ficus infectoria* leaves.

Table-3 *Effect of tannin on plane of nutrition and apparent nutrient digestibility in kids*

Attributes	Groups		SEM	P value
	T_1 Control	T_2 Tannin		
DMI				
g/d	627.51	653.95	10.67	0.107
Kg/100 kg BW	3.55	3.48	0.16	0.743
g/kg $W^{0.75}$	71.53	72.19	2.9	0.87
CP intake				
g/d	88.42	92.34	1.51	0.087
g/kg $W^{0.75}$	10.31	10.19	0.31	0.789
DCP intake				
g/d	55.9	60.02	1.58	0.083
g/kg $W^{0.75}$	6.55	6.63	0.27	0.849
TDN intake				
g/d	395.65	405.77	6.68	0.306
g/kg $W^{0.75}$	46.15	46.97	1.44	0.699
Apparent digestibility (%)				
DM	68.63	69.17	1.54	0.808
OM	70.71	72.15	1.46	0.495
CP	64.93^{b}	68.65^{a}	1.2	0.047
EE	65.97	70.69	1.96	0.116
CF	60.23	64.73	2.25	0.177
NFE	75.97	76.4	1.49	0.848

^{ab} Means with different superscripts within a row differ significantly (P<0.05)

Growth performance in goats

The data on growth performance of the kids is presented in [Table-4]. There was nonsignificant (P>0.05) difference of initial body weight between the groups. With respect to final body weight, tannin fed (T2) group had recorded significantly higher (P<0.05) body weight compared to control (T1) group. The total gain and average daily gain were also significantly higher (P<0.05) for the Surti kids under tannin fed group than control group. The higher growth rate might be due to beneficial effect of diet contains low levels of tannins, which has been generally attributed to the protection of feed protein from degradation in the rumen, leading to increase in the flux of essential amino acids (EAA) to small intestine and increase in the absorption of EAA to blood, although the response will vary as a variable nature as well as source of tannin.

Paswan *et al*. (2017) observed that the total gain and average daily gain of Black Bengal kids during experimental period was 3.27, 3.63, 4.10 and 3.12 (kg); and 36.3 40.4, 45.6 and 34.6 (g) under control, T1, T2 and T3, respectively and the differences were statistically significant (P<0.05). The present study was an agreement with the findings of Paswan *et al*. (2017). Significant difference in total weight gain and average daily gain were also reported by Dey *et al*. (2015) [25] in lambs fed tannin rich *Ficus infectoria* leaves. Our result also agrees with the findings of Uguru *et al*. (2014) who reported improvement (P<0.05) in total weight gain and average daily gain in goats fed diets containing sundried *Acacia nilotica* pods.

The feed conversion efficiency (FCE) was significantly (P<0.05) better in treatment group than control group. The efficiency of conversion of DM, CP, DCP and TDN was higher by 17.58%, 16.95%, 12.99% and 19.69%, respectively in T2 group than control group. The overall improvement in feed conversion efficiency observed in tannin (T2) group in the present study may be due to better growth rate in kids with lower consumption in this groups compared to control group.

These results are corroborated with the findings of Paswan *et al*. (2017), who reported that goat kids receiving TMR supplemented with 20% babul pod meal had 22.60% lower FCR than control group. Better conversion efficiency in babul pod supplemented group as compared to control group observed in the present study is in agreement with the findings of Dubey (2007) [26], who worked on degradation of tannins from *Acacia nilotica* pods and their influence on nutrient utilization, milk production and reproduction in dairy animals and observed that use of tannins below threshold level is beneficial in enhancing the milk production and efficiency of energy utilization in ruminants diet.

Jakkula *et al*. (2016) [27] found that two species of oak leaves namely *Quecus semecarpifolia* (CT 3.4%) and *Q. leucotricophora* (CT 1.7%) significantly improved feed gain ratio (DMI/unit body weight) (21.52 and 29.47, respectively) which were better than green grass fed group (39.35).

Table-4 *Effect of tannin on growth performance and feed conversion efficiency in kids*

Attributes	Groups		SEM	P value
	T_1 (Control)	T_2 (Tannin)		
Body weight changes				
Initial BW (kg)	13.54	13.66	0.84	0.917
Final BW (kg)	21.04^b	23.86^a	0.91	0.044
Total gain (kg/110 d)	7.51^b	10.20^a	0.45	0.008
ADG (g/d)	65.65^b	78.95^a	4.02	0.036
Feed conversion efficiency (FCE)				
DMI (kg/kg gain)	9.83^a	8.36^b	0.44	0.032
CPI (kg/kg gain)	1.38^a	1.18^b	0.06	0.033
DCPI (kg/kg gain)	0.87^a	0.77^b	0.01	0.046
TDNI (kg/kg gain)	6.20^a	5.18^b	0.28	0.024
^{ab} Means with different superscripts within a row differ significantly (P<0.05)				

Table-5 *Effect of tannin on economics of feeding*

Attributes	Groups		SEM	P value
	T_1 Control	T_2 Tannin		
Total feed consumption (kg)	83.04	86.37	1.37	0.104
Total cost of feeding (Rs.)	1167.6	1140.72	18.56	0.323
Cost (Rs./kg gain)	154.18^a	123.29^b	6.89	0.007
The realizable receipt from total gain of goat (Rs./head)	2251.50^b	3060.38^a	136.24	0.008
Return over feed cost (Rs./head)	1083.91^b	1919.65^a	123.67	0.002
Receipt as % of feed cost	192.16^b	267.88^a	9.48	6.042
Net Difference (Rs./Head)	-	835.74	-	-
^{ab} Means with different superscripts within a row differ significantly (P<0.05)				

Economics of feeding

The data on growth performance of the kids is presented in [Table-5]. There is no significant (P>0.05) difference of cumulative feed consumption and feed cost between the groups. The feed cost per kg weight gain was reduced by 20.04% in treatment group as compared to control group. The realizable receipt from total gain of goat (Rs./head) in experimental groups differed (P<0.05) statistically from each other. The return over feed cost (ROFC) was significantly higher (P<0.05) in tannin group as compared to control group. The net saving was Rs. 835.74 in tannin group over control during experimental period of 110 days on account of higher return over feed cost (ROFC).

Like our findings, Uguru *et al*. (2014) reported that feed cost/weight gain was cheapest in goats fed 25% level of sun-dried Acacia pods. Similar low cost per weight gain was reported by Mousa, M.R.M. (2011) [28] in lambs fed Acacia as supplements in basal diet. However, Parthasarathi *et al*. (2016) observed higher (P<0.01) feed cost/kg gain in lambs fed horse gram tannins incorporated diet over control diet.

Conclusion

The present findings suggested that Surti kids can be raised economically to the tune of 20.04% by feeding of tannin incorporated total mixed ration comprising of concentrate mixture with 18% babul pods and jowar hay with regards to better growth, better crude protein digestibility without affecting nutrient metabolism.

Application of Research: This research can be applied by poor farmers to rear goats economically by using easily available babul pods as feed.

Research Category: Phytonutrient

Abbreviations: BW-Body weight, TMR-Total mixed ration

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Cultivar / Variety / Breed name: Surti Kids

Conflict of Interest: None declared

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